

SATM

STEVENS ALLIANCE FOR TECHNOLOGY MANAGEMENT

Maximizing the Value of Your New Product Portfolio: Methods, Metrics & Scorecards

By Robert G. Cooper

EXECUTIVE SUMMARY

New product portfolio management is about how you invest your business's product development resources. It involves prioritizing the projects, both active and potential new ones, in the development portfolio and allocating resources across projects.

There are three goals in portfolio management: maximizing the value of the portfolio, seeking the right balance of projects, and ensuring that your portfolio is strategically aligned.

There are many tools – some quantitative, others

graphical, some strategic – designed to help you choose the right portfolio of projects.

Your portfolio management system should consist of a macro-decision process designed to allocate resources across strategic buckets, and a micro process, designed to select and prioritize specific projects.

Your gating or stage-gate process, along with effective portfolio reviews, are integral parts of your portfolio management process.

Portfolio Management

FUNDAMENTAL TO SUCCESSFUL PRODUCT DEVELOPMENT

Vital questions in product innovation management are these: How should the corporation most effectively invest its R&D and new product resources? And how should it prioritize its development projects and allocate resources among them? That is what portfolio management is all about: resource allocation to achieve corporate new product objectives. Much like a stock market portfolio manager, those senior executives who manage to optimize their R&D

investments – to define the right new product strategy for the firm, select the winning new product projects, and achieve the ideal balance of projects – will win in the long run.

Portfolio management is fundamental to successful new product development. Here's why:

- A successful new-product effort is fundamental to business success. This logically translates into portfolio manage-

Continued on next page

DIRECTOR'S NOTE:

With this issue, the SATM Newsletter takes on a new look. After almost six years, we thought it was time to freshen our design. We hope you like it.

We've also changed the name. Our publication has always been more than a newsletter, and we think that "Current Issues in Technology Management" is a more accurate reflection of what we've been covering in each issue.

What we are not changing is our tradition of bringing you provocative, timely articles representing the thinking of business and academic leaders about important issues in the field of technology management.

Our inaugural Spring 1997 issue highlighted an article by Robert Cooper on managing the front end of the innovation process. We are very pleased that Dr. Cooper, father of the stage-gate process for new product development and one of the world's leading authorities on managing the portfolio of new product projects, has provided the feature article for our new debut. In this issue, he distills the results of his years of research and writings in portfolio management to provide a succinct summary of the state-of-the-art in this critical area.

Larry Gastwirt

The Three Goals of Portfolio Management

GOAL #1. Maximize the Value of Your Portfolio: Here the goal is to select new product projects to maximize the sum of the values or commercial worths of all active projects in your development pipeline in terms of some business objective. Tools used to assess "project value" include:

- Productivity Index and Net Present Value (NPV). Each project's NPV is determined; projects are then ranked by NPV divided by the key or constraining resource (for example, the R&D costs still left to be spent on the project; that is, by NPV/R&D). Projects are rank-ordered according to this "productivity index" until out of resources, thus maximizing the value of the portfolio (the sum of the NPVs across all projects) for a given or limited resource expenditure.

- Productivity Index and Expected Commercial Value (ECV). This method uses decision-tree analysis, and breaks the project into decision stages: for example, Development and Commercialization (Exhibit 1).

Portfolio Management...

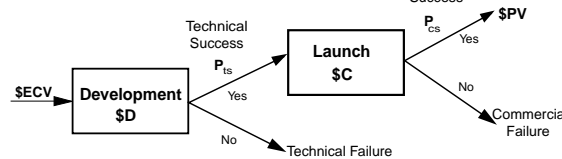
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ment: the ability to select today's projects that will become tomorrow's new-product winners.

- New-product development is the manifestation of your business's strategy. If your new product initiatives are wrong – the wrong projects, or the wrong balance – then you fail at implementing your business strategy.

- Portfolio management is about resource allocation. In a business world preoccupied with value to the shareholder and doing more with less, technology and marketing resources are simply too scarce to waste. The consequences of poor portfolio management are evident: you squander scarce resources, and as a result, starve the truly deserving projects. ■

Rank Order Projects Against Financial Criterion: Expected Commercial Value of Project



$$ECV = [(PV \cdot P_{CS} - C) \cdot P_{TS} - D]$$

SECV = Expected Commercial Value of the project

P_{TS} = Probability of Technical Success

P_{CS} = Probability of Commercial Success (given technical success)

SD = Development Costs remaining in the project

\$C = Commercialization (Launch) Costs

SPV = Present Value of project's future earnings (discounted to today)

The Productivity Index is calculated = ECV/Cost Remaining in Project. Projects are rank-ordered by this index until there are no more resources.

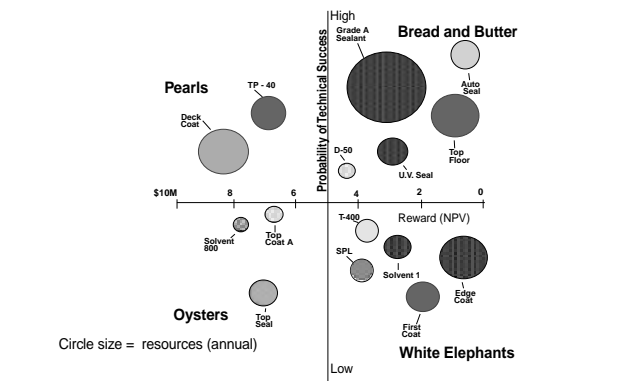
EXHIBIT 1

Next, the possible outcomes of the project, the probabilities of each occurring (for example probabilities of technical and commercial success), and the economic consequences of each are defined. The resulting ECV is then divided by the constraining resource (as in the NPV method above), and projects are rank-ordered according to this "probability-adjusted productivity index" in order to maximize the bang for buck.

This method also approximates real options theory, and thus is appropriate for handling higher risk projects.

- Balanced scorecard for NPD projects (scoring model): A more balanced list of rating criteria ought to include factors other than just financial, for example, strategic, leverage, and competitive advantage. Decision-makers rate projects on a number of factors that distinguish superior projects, typically on 1-5 or 0-10 scales. The ratings for each factor are added to yield a quantified Project

A Typical Risk-Reward Bubble Diagram

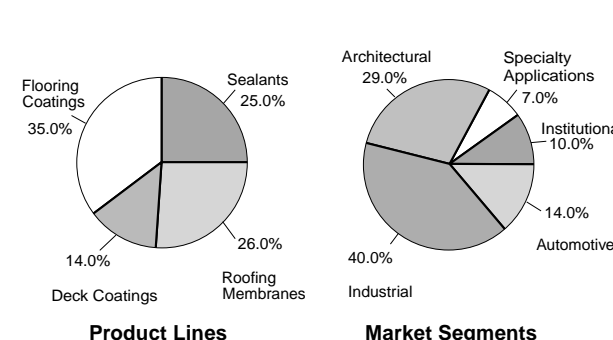


Management can see the allocation of resources (bubble size) and the risk-reward profile of their development portfolio

EXHIBIT 2

Attractiveness Score that must clear a minimum hurdle. This score is a proxy for the "value of the project" but incorporates factors beyond just financial measures. Projects are then rank-ordered according to this score until resources run out. Typical factors used in a scorecard are shown later, in Exhibit 9.

Breakdown of Resources by Product Lines & Markets



Resource breakdowns - the "what is" are displayed in a number of different pie charts - these are two samples

EXHIBIT 3

GOAL #2. Seek Balance in Your Portfolio: Here the goal is to achieve a desired balance of projects in terms of a number of parameters; for example, long term projects versus short ones; or high risk versus lower risk projects; and across various markets, tech-

nologies, product categories, and project types. Pictures portray balance much better than numbers and lists, so the techniques used here are largely graphical in nature. These include:

- **Bubble diagrams:** These display your projects on a two-dimensional grid as different-size bubbles, (the size of the bubbles denoting the spending on each project). The axes vary but the most popular chart is the risk-reward bubble diagram (Exhibit 2), where NPV is plotted versus probability of technical success. Management then seeks an appropriate balance in numbers of projects (and spending) across the four quadrants.

- **Pie charts:** These show your spending breakdowns (resources) as slices of pies in a pie chart. Popular pie charts include a breakdown by project types, by market or segment, and by product line or product category (Exhibit 3).

Unlike the maximization tools described under Goal #1, bubble diagrams and pie charts are not decision-models, but rather information display: they depict the current portfolio and where the resources are going – the "what is". These charts provide a useful beginning for the discussion of "what should be" – how should your resources be allocated.

Goal #3. Your Portfolio Must Be Strategically Aligned: This means that all your projects are "on strategy"; and that your breakdown of spending across projects, areas, markets, etc., must mirror your strategic priorities. Several portfolio methods are designed to achieve strategic alignment:

- **Top-down, Strategic Buckets:** This method begins with your business's strategy and from that, the product innovation strategy for your business – new product goals for the business (e.g., percentage of sales from new products), and where and how you wish to focus your new product efforts. Next, management makes splits in resources: "given your strategy, where should you spend your money?". These splits can be by project types, product lines, markets or industry sectors, and so on. Thus, you establish Strategic Buckets of resources (Exhibit 4). Then, within each

Continued on page 7

Popularity & Effectiveness of Portfolio Methods

In practice, financial methods dominate portfolio management, according to the best practices study cited above. Financial methods include various profitability and return metrics, such as NPV, ECV, ROI, EVA or payback period – metrics that are used to rate, rank order and ultimately select projects. Almost 80 percent of businesses surveyed use such an approach in portfolio management – see Exhibit 5. For 40% of businesses, this is the dominant method.

Other methods are also quite popular:

Strategic approaches: for instance, having decided the business's strategy, money is allocated across different types of projects and into different envelopes or buckets. Projects are then ranked or rated within buckets. Some 65 percent of businesses use this approach; this is the dominant method for one-fourth of the businesses surveyed.

Bubble diagrams or portfolio maps: 40 percent of businesses use portfolio maps; only 8 percent use this as their dominant method. The most popular map is the risk versus reward map in Exhibit 2, but many variants of bubble diagrams are used.

Scoring models: scaled ratings are added to yield a Project Attractiveness Score (Exhibit 9). These models are used by 38 percent of businesses; in 18 percent, this is the dominant decision method.

Check lists: projects are evaluated on a set of Yes/No questions. Each project must achieve either all Yes answers, or a certain number of Yes answers to proceed. The number of Yes's is used to make Go/Kill and/or prioritization (ranking) decisions. Fewer than 20 percent of businesses use check lists, and in only 3 percent is this the dominant method.

Popularity does not necessarily equate to effectiveness, however.

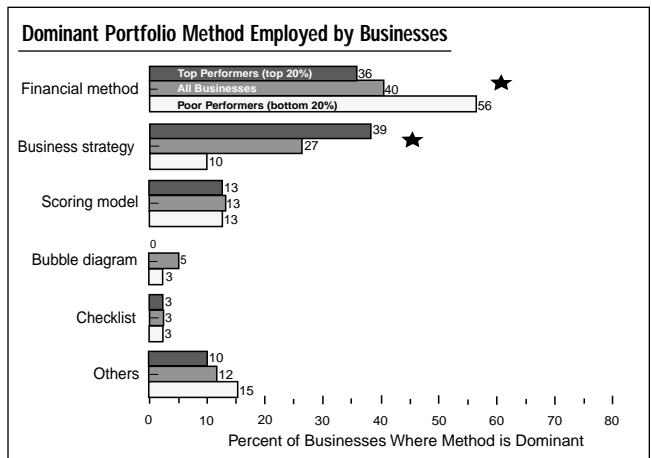
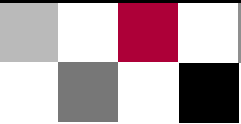


EXHIBIT 5

Strengths/Weaknesses for Each Portfolio Method

Performance Metric	Financial Methods	Strategic Methods	Scoring Model	Bubble Diagrams
Projects are aligned with business's objectives	3.76 ✘	4.08 ☆	3.95	4.11 ☆
Portfolio contains very high value projects	3.37 ✘	3.77	3.82 ☆	3.70
Spending reflects the business's strategy	3.50	3.72 ☆	3.59	3.00 ✘
Projects are done on time -- no gridlock	2.79 ✘	3.22 ☆	3.13	2.90
Portfolio has good balance of projects	2.80 ✘	3.08	3.20 ☆	3.20 ☆
Portfolio has right number of projects	2.50	2.93 ☆	2.70	2.25

☆ = Best method on each performance criterion
 ✘ = Worst method on each criterion.

Ratings are 1-5 mean scores for each method, when used as dominant portfolio method. Here 1=Poor and 5=Excellent

EXHIBIT 6

Continued on page 7

From Theory to Practice:

MANAGING YOUR NEW PRODUCT PORTFOLIO

How should you go about setting up a portfolio management system in your business?

First, recognize that there are really two levels of portfolio management decision-making (Exhibit 7):

- **Macro or high level:** this is strategic and answers the question – where should you spend your NPD resources (people and funds): on which types of projects, and in which markets, technologies or product types? That is, what should be your ideal spending splits or breakdowns?

spending targets or envelopes of resources in terms of:

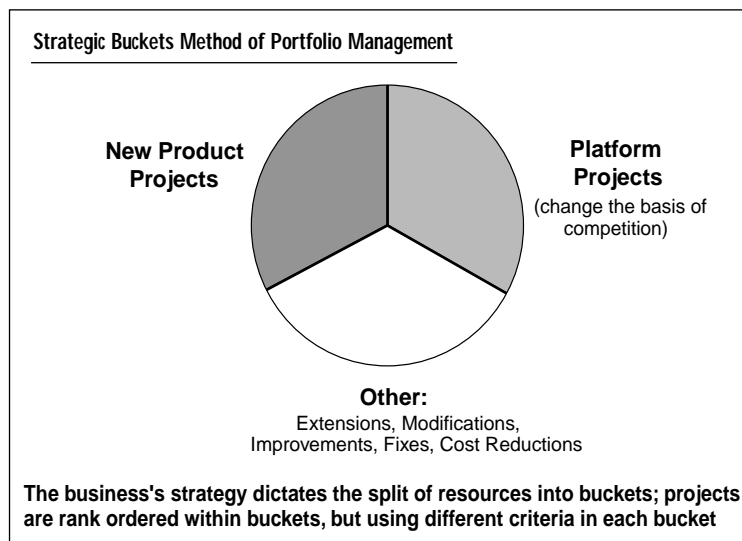
- Project types: for example, decide the spending split across platform developments; new products; product improvements, extensions and modifications; and costs reductions, similar to Exhibit 4.
- Business areas: for example across mar-

kets or sectors; or by product types or product lines; or across technologies. Management typically goes through a process that begins with the "what is", reviews the proposed strategy and major projects underway, perhaps considers splits for best-in-class companies, and then makes ideal splits for the future.

Micro or project selection: Two decision processes are at work here (Exhibit 7). The first is your gating or stage-gate process – see Exhibit 8.

Many businesses have an idea-to-launch new product process in place, and embedded within it are the gates or Go/Kill decision points. Gates provide an in-depth review of individual projects, and render Go/Kill, prioritization and resource allocation decisions. Best practice companies are bringing more rigor to gate decisions by:

- ensuring that best practices are evident within the stages – that project teams really do undertake the needed up-front homework, the voice-of-customer assessment, and put together a high quality, fact-based business case
- demanding consistent and quality information inputs to gates (in the form of pre-specified deliverables);



kets or sectors; or by product types or product lines; or across technologies. Management typically goes through a process that begins with the "what is", reviews the proposed strategy and major projects underway, perhaps considers splits for best-in-class companies,

EXHIBIT 4

- **Micro or lower level:** this is more tactical, but obviously follows from the macro decisions, and addresses the question: what specific new product projects should you do? And what resources should be allocated to each – what are their relative priorities?

Macro or spending splits: The macro decisions follows logically from your business's strategy and its product innovation and technology strategy. The development of Strategic Buckets, outlined above and in Exhibit 4, is the most appropriate tool here. Buckets can be developed to set

The Portfolio Management Process & its Elements – The Two Levels of Decision-Making

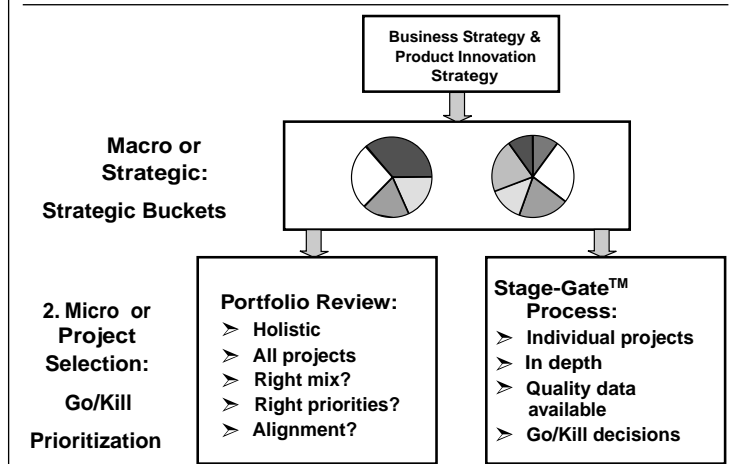


EXHIBIT 7

- ensuring that the right decision-makers or "gatekeepers" are at the gate – the resource owners (often this is the leadership team of the business); and
- relying on a balanced scorecard or scoring model to bring rigor, consistency and efficacy to the gate decision-making process.

An Overview of a Typical Stage-Gate™ Process

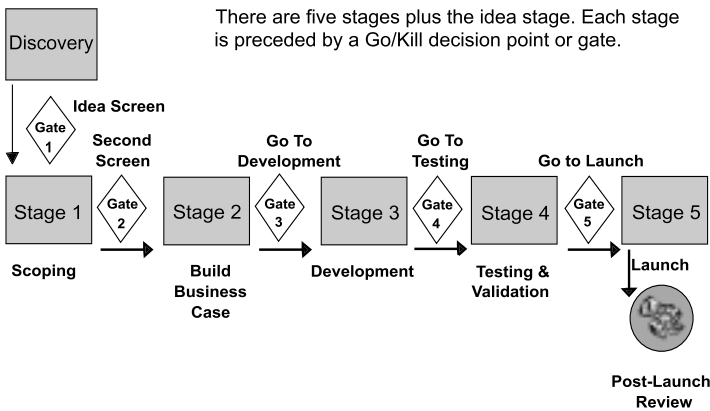


EXHIBIT 8

Projects are scored on scales by the gatekeepers right at the gate meeting; scores are entered, displayed and debated at the meeting, and the decision is made. A sample listing of scorecard criteria is provided in Exhibit 9.

An effective stage-and-gate new product process enhances portfolio management in several ways. First, better project data should become available: this helps make project selection decisions more effective. Second, the gates provide tough reviews, and should eliminate lower-value projects, thereby improving the overall quality of the project portfolio. Experience has shown that implementation of an effective stage-gate process is a prerequisite to making portfolio management work.

The second decision process for project selection is the periodic portfolio review (bottom left of Exhibit 7). This takes place 2-4 times per year, and is where senior management looks at all projects together. A typical procedure is this:

- 1 The business's strategy is reviewed.
- 2 Next, the Must Do projects are identified, and removed from the meeting or "auction"; resources are secured for these top priority projects.
- 3 Won't Do projects might also be pinpointed (in effect, an immediate gate meeting is held on these). Some might be killed outright. The ranking of the remaining projects – those "in the middle" – is outlined and debated (one can use the scorecard scores or a productivity index to rank projects until out of resources).
- 4 The balance and mix of projects is now debated (various pie charts and bubble diagrams, as in Exhibits 2 and 3; or a summary as in Exhibit 10).
- 5 Additional resources may be allocated (or re-allocated) and adjustments to the portfolio of projects are made.

Note that the gates are project-specific and provide a thorough review of each project – in-depth and in real time. By contrast, the portfolio reviews are holistic – they look at all projects together, but in much less detail on each project. ■

What should be your ideal spending splits or breakdowns?

What specific new product projects should you do?

What resources should be allocated to each – what are their relative priorities?

Sample Go-to-Development Gate Scorecard Criteria

- **Strategic:**
 - degree to which project aligns with business's strategy
 - strategic importance
- **Product Advantage:**
 - unique benefits for customers
 - meets customer needs better
 - value for money (value proposition)
- **Market Attractiveness:**
 - market size
 - market growth
 - competitive situation
- **Synergies (Leverages Core Competencies):**
 - marketing synergies
 - technological synergies
 - Manufacturing/processing synergies
- **Technical Feasibility:**
 - technical gap
 - complexity
 - technical uncertainty
- **Risk Vs. Return:**
 - expected profitability (magnitude; e.g. NPV)
 - return (e.g. IRR)
 - payback period
 - certainty of return/profit estimates
 - low cost & fast to do

- The six factors in bold are scored (e.g., 1-5 or 0-10) on a scorecard
- Factor scores must clear minimum hurdles
- Also are added (weighted/unweighted) to yield Project Attractiveness Score - used to make Go/Kill decisions at Gates and to rank projects at Portfolio Reviews

EXHIBIT 9

At Portfolio Review & Gate Meetings, Display the Portfolio – Check for Balance & Alignment

Project	Rank/Priority Level	Total Project Score	Portfolio Balance Factor	Adjusted Total Project Score
Soye-44	1	80	1.10	88
Encapsulated	2	82	1.00	82
Legume N-2	3	70	1.10	77
Spread-Ease	4	75	1.00	75
Charcoal-Base	5	80	0.90	72
Projects on Hold				
N2-Fix	1	80	1.00	80**
Slow-Release	2	70	1.10	77*
Multi-Purpose	3	75	.90	68
etc.	etc.			

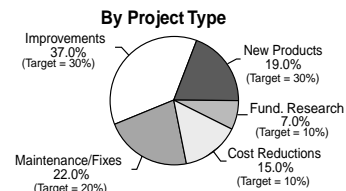
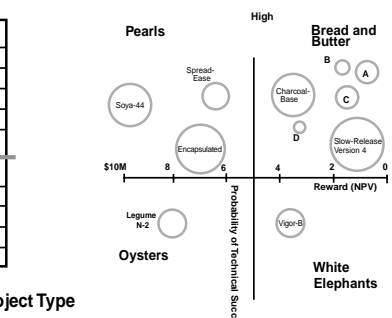


EXHIBIT 10

Book Review

PORTFOLIO MANAGEMENT FOR NEW PRODUCTS, SECOND EDITION

AUTHORS: ROBERT G. COOPER, SCOTT J. EDGETT, & ELKO J. KLEINSCHMIDT

PUBLISHED IN 2001 BY PERSEUS PUBLISHING, CAMBRIDGE, MA

By Jack McGourty

If the foregoing article has you thinking about renovating your portfolio management process, you will want to read this book. The authors, Robert Cooper, Scott Edgett, and Elko Kleinschmidt, have provided a comprehensive guide to managing a company's portfolio of products, based on their extensive research into product development practices and performance across several industries. This updated classic is an important addition to the library of anyone involved in product development and management.

The authors make a clear case why portfolio management is important to corporate profitability. Using an extensive database of research data and field experience, the difficulties that firms face in allocating resources for new products are detailed, as well as the challenges managers face in managing portfolios. The authors' data prove that effective portfolio management is critical to a firm's long-term profitability. Profitability stems from the capability of the firm to select the right balance of projects and investments. This balance is a result of management's ability to communicate strategies and project priorities and to select products for development objectively.

Once the importance of portfolio management is illustrated, several chapters are dedicated to methods that leading corporations employ in developing their new product portfolios. For example, several financial methods are described that help firms to maximize the value of their product portfolios. The end result of using these methods is a rank-ordered list of projects based on one or more business objectives such as profitability, risk, etc. The authors go beyond the description of these maximization approaches by providing examples of scoring models employed by several organizations known for their product development success. The information in this chapter is worth the price

of the book. However, the authors go into equal breadth and depth on how to achieve a balanced portfolio and ensure that there is a strong link to business and technology strategies.

Once the various approaches are described in great detail, the authors take an equal degree of effort to discuss how portfolio management effectiveness is to be measured. How the portfolio and related management processes are working is a most vital question. How specific portfolio methods perform is explored in a manner that

challenges. In addition, the processes themselves are held to intense scrutiny, ensuring that the reader understands that effective portfolio has its challenges and takes real commitment on the part of management. Much of the practical advice is integrated within each chapter's narrative. However, the authors dispense more advice through a feature they label "Points for Management to Ponder." These frequent sidebars provide a manager with thought-provoking questions to consider as they work their way through the book's material and how it best applies to their specific organizational situation. This

The authors... have provided a comprehensive guide to managing a company's portfolio of products, based on their extensive research into product development practices and performance across several industries.

This updated classic is an important addition to the library of anyone involved in product development and management.

illustrates both their strengths and weaknesses. The conclusion is that the best-managed portfolios are the result of using multiple methods – usually a combination of strategic, financial, and scoring model approaches. While many management books conclude with the cliché that no one approach is the best, these authors provide enough detail for the reader to understand how to best combine methods based on what you are attempting to accomplish with your product portfolio.

The book provides a great deal of practical advice. Based on extensive observations and applied research, the authors discuss what seems to work in portfolio management and what doesn't. Portfolio management processes are not advocated as the panacea to all product management chal-

lenges. In addition, the processes themselves are held to intense scrutiny, ensuring that the reader understands that effective portfolio has its challenges and takes real commitment on the part of management. Much of the practical advice is integrated within each chapter's narrative. However, the authors dispense more advice through a feature they label "Points for Management to Ponder." These frequent sidebars provide a manager with thought-provoking questions to consider as they work their way through the book's material and how it best applies to their specific organizational situation. This

simple tool enables the reader to consider how the practices described best apply to his or her business.

The final chapter of the book deals with implementation – how to best design and institute an effective portfolio management process in one's organization. Again, the authors provide a systematic approach to how to best proceed. However, to the authors' credit, they are always advocating caution. "Don't jump right in" is a prevailing theme. Perhaps this is one of the wisest recommendations of this book in general.

When you are finished reading it, you will want to jump right in and begin employing a portfolio management program. However, you will realize that you must proceed in a cautious, well-planned manner with many points to ponder on the way. ■



Three Goals...

Continued from page 3

bucket, you list all the projects – active, on-hold and new – and rank these until you run out of resources in that bucket. The result is multiple portfolios, one portfolio per bucket. Another result is that your spending at year-end will truly reflect the strategic priorities of your business.

- Top-down, product roadmap: Once again, management begins with your business and product innovation strategy. But here the question is: "given that you have selected several areas of strategic focus – markets, technologies or product types – what major initiatives must you undertake in order to be successful here?". It's analogous to the military general asking: given that I wish to succeed in this strategic arena, what major initiatives and assaults must I undertake in order to win here? The end result is a mapping of these major initiatives along a timeline of several years – the product roadmap. The selected projects are 100% strategically driven.
- Bottom-up: "Make good decisions on individual projects, and the portfolio will take care of itself" is a commonly accepted philosophy. That is, make sure that your project gating system is working well – that gates are accepting good projects, and killing the poor ones – and the resulting portfolio will be a solid one. To ensure strategic alignment, consider using a scoring model or balanced scorecard at your project reviews and gates (as in Goal #1), and include strategic questions in this model. Strategic alignment is all but assured: your portfolio will indeed consist of all "on strategy" projects (although spending splits may not coincide with strategic priorities).

Note that regardless of the strategic approach here, all of these methods presuppose that your business does indeed have a product innovation and technology strategy, something that many businesses lack. ■

Popularity...

Continued from page 3

When the performance of firms' portfolios were rated on six metrics in this study, companies that relied heavily on financial tools as the dominant portfolio selection model fared the worst (Exhibit 6). Financial tools yield an unbalanced portfolio of lower value projects, and projects that lack strategic alignment. By contrast, strategic methods produce a strategically aligned and balanced portfolio. Scoring models appear best for selecting high value projects, and also yield a balanced portfolio. Finally, firms using bubble diagrams obtain a balanced and strategic aligned portfolio.

It is ironic that the most rigorous techniques – the various financial tools – yield the worst results, not so much because the methods are flawed, but simply because reliable financial data are often missing at the very point in a project where the key project selection decisions are made. ■

The author:

Robert G. Cooper is President of the Product Development Institute, Inc., Professor of Marketing at the DeGroote School of Business, McMaster University, Ontario, Canada, and an ISBM (Institute for the Study of Business Markets) Distinguished Research Fellow at Penn State University's Smeal College of Business Administration. Creator of the widely employed Stage-Gate™ product development process, he is the author of *Winning at New Products*, *Portfolio Management for New Products*, and *Product Leadership*.

Implement a Portfolio Management Process in Your Business

Portfolio management is fundamental to new product success. But it's not as easy as it seems. Effective portfolio management requires that you first have an effective gating or stage-gate process in place – both to generate better quality and consistent data on projects, and also to kill some bad projects early. Next, you should map out your portfolio management process or system, perhaps using Exhibit 7 as a guide. This mapping can be complex and difficult, and is best handled by a cross-functional task force. Now comes implementation: training and education; running some pilot sessions; and of course providing IT support (a comprehensive database on all projects complete with relevant portfolio displays).

Installing a comprehensive portfolio management process does take effort. But the results appear worth the effort: the latest APQC benchmarking study reveals that having a systematic portfolio management process for new product development is one of the top ten best practices in new product development, and strongly discriminates between the Best and Worst NPD Performing businesses. ■

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UPCOMING EVENTS

The next Roundtable meeting will be held on Monday, March 10 from 2:00-5:00 PM at Stevens Institute of Technology. It will feature a review of faculty research projects being carried out under Alliance sponsorship.

The 2003 Alliance for Technology Management Conference is being held on Tuesday, May 6, from 9:00 AM to 4:00 PM at AT&T in Bedminster, NJ. The Conference topic is business process redesign, specifically focusing on managing technology as a high performance business. The keynote speaker is **Martin Stankard**, whose 2002 book, "Management Systems and Organizational Performance," redesigns and simplifies the Baldrige Criteria for use in boosting business performance.

The formal announcement with description, speakers, directions, etc. will be issued around March 1.

For further information on these and other Alliance activities, contact Dr. Lawrence Gastwirt: **212-794-3637 • lgastwirt@aol.com**

INFORMATION

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Endnotes:

More information on these portfolio management methods can be obtained from: Cooper, R.G., Edgett, S.J. and Kleinschmidt, E.J., *Portfolio Management for New Products*, 2nd edition. Reading, Mass: Perseus Books, 2002. (Reviewed in this issue)

Parts of this article are taken from previous publications by the author and co-workers S.J. Edgett & E.J. Kleinschmidt: "Portfolio management in new product development: lessons from the leaders - Part I", *Research-Technology Management* 40(5), Sept.-Oct. 1997, 16-28; "Portfolio management in new product development: lessons from the leaders - Part II", *Research-Technology Management* 40(6), Nov.-Dec. 1997, 43-52; "Best practices for managing R&D portfolios", *Research-Technology Management*, 41, 4, July-Aug. 1998, 20-33; "New product portfolio management: practices and performance", *Journal of Product Innovation Management*, 16,4, July 1999, pp 333-351; "New problems, new solutions: making portfolio management more effective", *Research-Technology Management*, 2000, 43, 2, 18-33; and "Portfolio Management: Fundamental to New Product Success", in *The PDMA Toolbox for New Product development*, edited by P. Beliveau, A. Griffin and S. Somermeyer. New York: John Wiley & Sons, Inc., 2002, pp. 331-364.

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